AN IMPROVED SAME POTENTIAL BLOCK SUCH AS A GROUNDING BLOCK AND METHOD FOR MAKING AN IMPROVED SAME POTENTIAL BLOCK

BACKGROUND OF THE INVENTION

Computers and other signal processing devices utilize connectors to communicate signals to locations exterior to the computer. The signals are typically transmitted through a plurality of wires or cables which are connected to the computer through a connector. Shielded wires or shielded cables (hereinafter referred to collectively as "shielded wires") have a conductive shield braid surrounding signal wire(s) on which the signals are transmitted. The shield braid prevents noise from appearing on the signal wire, controlling interference between adjacent signal wires.

The shield braid of each shielded wire is grounded. Shielded wires have their signal wire connected directly into the connector, but may connect the shield braid to an exterior portion of the connector to ground the shield braid. Typically, the shielded wire has a length of insulation removed to expose the shield braid. A shield ground wire is attached at one end to the shield braid and attached at the other end directly to the connector (for example, connecting to a ring terminal which is attached to the connector through a screw) or connected indirectly to the connector through a grounding block (also called a ground block).

The grounding block includes multiple terminals, each of which is adapted to have a pin which is affixed to the shield ground wire accommodated therein. Grounding blocks allow connections of the shielded cable to be made easily.

However, prior art grounding blocks have been relatively complicated to manufacture, thus increasing their cost to manufacture. The prior art grounding blocks may utilize relative expensive metal castings, machined metal components and polymers. As many as sixty-four different components were used to produce one prior art multi-pin grounding block.

SUMMARY OF THE INVENTION

The present invention is directed to a grounding block or other same-potential block having simple construction and a method for manufacturing such a grounding block or other same-potential block.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates an exploded view of the grounding block;

Figure 2 illustrates the grounding block assembled with a cut-away view of the main body and slave clip;

Figures 3A-3D illustrate one example of a main body. Figures 3A and 3B illustrate perspective views of opposite sides of the main body. Figure 3C illustrates a cut-away view of a portion of the main body corresponding to cross-section IIIC-IIIC shown in Figure 3B. Figure 3D is a blown-up illustration of the end portion of the main body.

Figures 4A and 4B illustrate one example of a main clip. Figure 4A illustrates a front view of the main clip. Figure 4B illustrates a side view of the main clip.

Figures 5A, 5B and 5C illustrate one example of a slave clip. Figure 5A illustrates a front view of a slave clip. Figure 5B illustrates a top view of the slave clip. Figure 5C illustrates a side view of the slave clip.

Figures 6A, 6B and 6C illustrate one example of a cap. Figure 6A illustrates a bottom view of the cap. Figure 6B illustrates a cross-section along the length of the cap. Figure 6C illustrates a cross-section along the width of the cap. Figure 6D is a blown-up illustration of a portion of Figure 6C.

Figures 7A, 7B and 7C illustrate in a simplified manner how a pin 500 connects to a terminal of the grounding block.

Figure 8A is a top view and Figure 8B is a side view with cutaway views of another example of a main body. Figure 8C illustrates a cross section of the main body illustrated in Figures 8A and 8B. Figure 8D illustrates a blown-up portion of Figure 8C. Figure 8E illustrates a blown-up portion of Figure 8A.

Figure 9A illustrates a top view of another example of a cap. Figure 9B illustrates a cross section of the cap of Figure 9A. Figure 9C illustrates a blown-up portion of Figure 9B.

Figure 10A is a top view, Figure 10B is a front view and Figure 10C is a side view of another example of a slave clip. Figure 10D is a blown-up view of a portion of Figure 10C.

DETAILED DESCRIPTION

At the outset, it is emphasized that the following detailed description merely sets forth one example of the invention. Advantages of the many aspects of the elements of this example will be apparent to those skilled in the art. Not all aspects of the detailed example are intended to be a required part of the invention as the invention is broadly defined. It is emphasized that the spirit and scope of the invention is only intended to be defined by the claims.

The following description uses the term "grounding block" to describe the detailed example to simplify the description. However, it should be understood that the block is not required to be grounded; it is also contemplated that the block be used as a same-potential block where the block is used to deliver the same potential (other than a ground potential) to a plurality of conductors. For example, this invention is also intended for use as either a modular block or a bussing block for either power or signals of the same potential.

Figure 1 illustrates an exploded view of the grounding block, including a main body 100, a main clip 200, a slave clip 300, a cap 400 and metallic eyelets/rivets 600. Also illustrated are pins 500 which may be connected into the grounding block.

Figure 2 illustrates the grounding block assembled with a cut-away view of the main body and slave clip to show how the elements are assembled. Further description of this assembly in Figure 2 will be

discussed below after the following detailed description of examples of the main body 100, main clip 200, slave clip 300 and cap 400.

Figures 3A-3D illustrate one example of the main body 100. Figures 3A and 3B illustrate perspective views of opposite sides of main body 100. As illustrated, main body 100 is substantially rectangular in shape having a hollow 102 formed on an elongated side. Holes 104 are formed to extend through the major surfaces of main body 100 at opposite ends thereof. As shown best in Figure 3A, indentations 106 may be formed in the main body at positions about holes 104.

Figure 3D is a blown-up illustration of the end portion of main body 100. One wall of hollow 102 includes a slot 108 which extends from a major surface of the main body into hollow 102. A second slot 108 is formed at the opposite end of hollow 102.

Figure 3C illustrates a cut-away view of a portion of the main body corresponding to cross-section IIIC-IIIC shown in Figure 3B. As illustrated in Figure 3C, hollow portion 102 is defined on one side by a carrier strip resting surface 102a. Extending from carrier strip resting surface 102a through the main body are a plurality of holes 110. Each hole 110 includes a first large diameter or large width portion 110a and a second small diameter or small width portion 110b. For each hole 110, large diameter portion 110a extends from surface 102a and connects to small diameter portion 110b, which in turn extends through the main body 100. A ledge 110c is formed where the large diameter portion 110a meets the small diameter portion 110b. The shape of the large diameter portion 110a and

the small diameter portion 110b are not necessarily cylindrical. The shapes preferably are designed for housing a certain pin and to allow insertion of a special jig to remove the pin, as in this example.

Figures 4A and 4B illustrate one example of main clip 200. Figure 4A illustrates a front view of main clip 200. Figure 4B illustrates a side view of main clip 200. Clip 200 is preferably made out of metal and formed by stamping a single sheet of metal. Clip 200 includes a carrier strip 202 from which extend a plurality of clips 204 in a direction substantially perpendicular to the length of the carrier strip 202. Each clip 204 includes a locking tang 204a extending from the middle of a support surface 204c of clip 204 and a contacting tang 204b extending from an end of this support surface 204c. Both the locking tang 204a and contacting tang 204b extend from support surface 204c in a direction away from the carrier strip 202 and form an angle with support surface 204c.

At each end of carrier strip 202, arms 206 are formed to extend in a direction perpendicular to the surface of carrier strip 202. Arms 206 connect carrier strip 202 to an exterior contact portion which includes elements 208, 214 and 216. Side portions 208 are elongated. One end of each side portion 208 is connected to a respective arm 206. At ends opposite arms 206, side portions 208 are connected to a contacting surface 214. In middles of side portions 208 are holes 210. Surrounding holes 210 are extrusions 212 extending away from the surfaces of side portions 208. Contacting surface 219 extends in the same direction as carrier strip 202 between the two side portions 208. Extending from a

bottom end of contacting surface 214 are three large continuity springs 216.

Figure 5A illustrates a front view of slave clip 300. Figure 5B illustrates a top view of slave clip 300. Figure 5C illustrates a side view of slave clip 300. As shown in Figures 5A, 5B and 5C, slave clip 300 includes a carrier strip 302. As best shown in Figure 5B, carrier strip 302 is bent such that it has a cross-section, in the direction in which it extends, of a plurality of adjacent "U" shapes. Ends of adjacent "U" shaped portions of carrier strip 302 are connected to form projections 302a. The slave clip 300 further includes a plurality of clips 304, each of which extend in a direction perpendicular to the direction in which carrier strip 302 is elongated and from a corresponding "U" shaped portion of carrier strip 302. Similar to the above described clips 204 of main clip 200, each clip 304 includes a locking tang 304a, a contacting tang 304b and a support surface 304c. The support surface 304c extends substantially perpendicular to the direction in which the carrier strip 302 is elongated. Extending from the middle of support surface 304 away from carrier strip 302 is a locking tang 304a. Extending from the end of support surface 304c in a direction away from carrier strip 302 is a contacting tang 304b. Both the locking tang 304a and contacting tang 304b form an angle with support surface 304c.

Figure 6A illustrates a bottom view of cap 400. Figure 6B illustrates a cross-section along the length of cap 400. Figure 6C illustrates a cross-section along the width of cap 400. Figure 6D is a blown-up illustration of a portion of Figure 6C. Cap 400 may be formed of a polymer material.

The exterior shape of cap 400 is designed to fit snugly within hollow 102 of main body 100. As shown, cap 400 includes a plurality of holes 410. These holes extend from the top to the bottom of cap 400, positioned side by side along the length of cap 400. The diameter of holes 410 correspond to the size of the larger diameter portion 110a of holes 110 of main body 100. Additionally, the location of holes 410 correspond in location to holes 110 of the main body 100 such that when cap 400 is inserted into hollow 102 of main body 100, holes 410 are axially aligned with holes 110.

On each side of the length of cap 400 are slots 408. Each slot 408 has a height which extends from the bottom of cap 400 towards the top of cap 400, but ends in a middle portion of cap 400. The lengths of slots 408 are perpendicular to the length of cap 400. When cap 400 is inserted into hollow 102 of main body 100, slots 408 will align with slots 108 of main body 100.

Extending along the length of cap 400 between slots 408 are a plurality of wedge shaped slots 402. The wedge shaped slots 402 have heights which extend from the bottom of cap 400 towards the top of cap 400, but end in a middle portion of cap 400. The wedge shaped slots 402 are aligned in a direction of their length, connecting each hole 410, as well as connecting slots 408 to the two holes at either end of cap 400. The plurality of wedge shaped slots 402 are positioned and shaped to encompass portions of carrier strip 202 of main clip 200 and carrier strip 302 of slave clip 300, as will be described further below.

Referring to Figures 1 and 2, the simple assembly of the grounding block is explained. Clips 204 of main clip 200 are inserted into corresponding holes 110 of main body 100. Carrier strip 202 of main clip 200, from which clips 204 extend, is positioned to rest upon carrier strip resting surface 102a. Arms 206 extending from carrier strip 202 are positioned within respective slots 108. Exterior contact portion (208, 214, 216) thus is positioned exterior to main body 100.

Similarly, the plurality of clips 304 of slave clip 300 are positioned in corresponding holes 110 of main body 100. Each hole 110 of main body 100 thereby houses a pair of clips (204, 304). Carrier strip 302, from which clips 304 extend, is also positioned to rest on carrier strip resting surface 102a (defining part of hollow 102). As can be seen best in Figure 2, projections 302a of carrier strip 302 come in contact with carrier strip 202.

Cap 400 is then inserted into hollow 102 of main body 100. Cap 400 may be fixed in hollow 102 simply from friction between the walls defining hollow 102 and corresponding exterior surfaces of cap 400. Adhesive may also be used to connect cap 400 to main body 100. Slots 408 on either end of cap 400 slide down around arms 206 of main clip 200. The plurality of wedge shape slots 402 each encompass a projection 302a of carrier strip 302 and a portion of carrier strip 202 adjacent to a corresponding projection 302a. The wedge shape of each wedge shape slot 402 acts to force carrier strip 302 into contact with carrier strip 202 at each projection 302a.

Additionally, metallic eyelets/rivets 600 (see Figure 1) may be inserted through holes 104 of main body 100. These eyelets/rivets 600 accept a screw which is utilized to connect the grounding block to a connector or a conductor associated with the grounding block. The screw passes through holes 210 of main clip 200 and holes 104 of main body 100. The eyelets/rivets 600 protect the plastic of the main body 100 from the screw. Extrusions 212 extending from the exterior of holes 210 act as springs when the eyelets/rivets 600 are inserted. The use of holes 104, holes 210 and eyelets/rivets is optional. Alternative ways of connecting the grounding block to a connector can be used. For example, clips may be formed on main clip 200 to snap a grounding block to a connector.

As noted above, both the main clip 200 and slave clip 300 may be formed from stamping a metal sheet, thus may be easier and less expensive to manufacture. The carrier strip 202 of main clip 200 can alternatively be made to also include a plurality of "U" shapes (similar to slave clip 300). However, carrier strip 202 of main clip 200 is made flat, the pre-stamping width of the top portion of main clip 200 (including carrier strip 202) substantially corresponds to the pre-stamping width of the bottom portion of main clip 200 (including contacting surface 214). If this width is not the same, folds or bumps in the bottom portion may be necessary to give the top portion and bottom portions proper widths after stamping. For example, due to arms 206, a small ridge is made on either side of contacting surface 214 to adjust the width of the bottom portion of main clip 200.

Figures 7A, 7B and 7C illustrate in a simplified manner how a pin 500 connects to a terminal of the grounding block. A terminal of the grounding block is formed in each hole 110 of the main body 100. Each hole 110 of the main body 100 has positioned therein a clip 204 of main clip 200 and a clip 304 of slave clip 300. Pin 500 may be connected to a shield ground wire in a known manner (e.g., crimping or soldering).

The pin 500 is inserted into hole 110. The tip 502 of pin 500 slides past the locking tangs 204a and 304a (Figure 7B) and the contacting tangs 204b and 304b (Figure 7C). The angle of the locking tangs 204a and 304a, as well as the contacting tangs 204b and 304b allow the tangs to be easily pushed away from pin 500 towards the sides of the hole 110. Pin 500 is pushed into hole 110 until protrusion 504 slides past locking tangs 204a and 304a, allowing these locking tangs to snap back towards the center of the hole 110. While not shown in Figures 7A, 7B and 7C, the pin 500 may be prevented from further movement in this pushing direction from ledge 110c formed between large diameter portion 110a and small diameter portion 110b of hole 110 (see Figures 2 and 3C).

Contacting tangs 204b and 304b are biased to contact the end of pin 500 to establish an electrical connection. Pin 500 is prevented from being removed from hole 110 due to locking tangs 204a and 304a. After protrusion 504 of pin 500 has been pushed past locking tangs 204a and 304a in the downward direction (in Figure 7C), movement in the upward direction is prevented, as locking tangs 204a and 304a have moved back again towards the center of hole 110 due to their natural biasing. Upon

movement of pin 500 in the upward direction (in Figure 7C), force exerted by protrusion 504 is substantially along the length of locking tangs 204a and 304a and does not cause the locking tangs to be pushed to the sides of hole 110.

Before or after all the shield ground wires have been connected into a corresponding hole, the grounding block may be easily attached to an appropriate conductor (for example, of a connector). The contacting surface 214 establishes an electrical connection between the grounding block and this connector. Continuity springs 216 extend to connect with a second pair of a grounding block and a connector to provide continuity of potential between the two grounding blocks and their associated connectors.

Thus, for each shield braid surrounding a signal wire, an electrical connection may be established easily from the shield braid to a shield ground wire to pin 500 to contacting tangs 204b and 304b up through each clip 204 and 304 through carrier strips 202 and 302 through arms 206 to the exterior contact portion (including side portion 208 and contacting surface 214). The contacting surface 214, contacting the appropriate portion of the connector, allows the shield braids of the shielded wires to be appropriately grounded. The continuity springs 216 allow the ground to be conducted between two mating connectors, one to which this grounding block is attached. The other grounding block may be the same as this grounding block, except that the continuity springs 216 may be

omitted (because they would duplicate the function of the one grounding block's continuity springs 216).

Figures 8A-8F illustrate details of another example of a main body. Figures 9A-9C illustrate details of another example of a cap. Instead of or in addition to connecting the cap to the main body via a friction fit, the cap and the main body may be connected by ultrasonically welding. Figure 8A is a top view and Figure 8B is a side view with cutaway views of another example of the main body 100'. Main body 100' has two shelf portions 112' formed on either end of hollow 102'. The shelf portions 112' form an intermediate step between the carrier strip resting surface 102a' and the exterior of main body 100'. Figure 8C illustrates a cross section of main body 100' at one of the shelf portions 112' and Figure 8D illustrates a blown-up portion of Figure 8C. Figure 8E illustrates a blown-up portion of Figure 8A. As best shown in Figures 8C, 8D and 8E, each shelf portion 112' has a plurality of ridges 114' formed thereon. In this example, the ridges 114' run parallel to the length of the main body 100'.

Hollow 102' is partially defined by two opposing surfaces 102b' which extend along the length of the main body 100' and are perpendicular to the carrier strip resting surface 102a'. On each of the two opposing surfaces 102b' a plurality of tower-like projections 116' are formed. Each of the projections 116' extend perpendicular to the carrier strip resting surface 102a' and project away from a corresponding surface 102b' on which the projections 116' is formed. Each projection 116' includes a base part 116a' having a extending from the carrier strip resting surface 102a'.

The upper surfaces of the wide base part 116a' are substantially flat and at the same level. Each projection 116' also has a ridge part and a smaller ridge part 116b' extending from the upper surface its base part 116b'. The ridge part is smaller than the base part 116'.

Figure 9A illustrates a top view of another example of a cap 400'. Figure 9B illustrates a cross section of cap 400'. Figure 9C illustrates a blown-up portion of an end of cap 400'. As illustrated in Figures 9A, 9B and 9C, cap 400' includes shoulder portions 412' on either end of the cap. On each shoulder portion, a plurality of ridges 414' are formed. In this example, the ridges 414' are perpendicular to the length of cap 400'.

A main clip and slave clip may be inserted into main body 100' as described above in connection with the first example. When cap 400' is inserted into hollow 102' of main body 100', the cap will come to rest upon base portions 116a'. Unlike cap 400, cap 400' does not have any wedge portions (or other cavities) to accept portions of the slave clip and the main clip. Thus, base portions 116a' of the main body 100' prevent the cap 400' from being inserted too far into the hollow 102' and thus prevent possible damage to the main clip and the slave clip.

In addition or alternative to any friction fit between the main body 100' and the cap 400', the main body 100' and the cap 400' are connected via an ultrasonic welding. More specifically, the main body 100' and the cap 400' are subjected to ultrasonic radiation which melts ridges 114' and ridge parts 116b' of main body 100' and ridges 414' of cap 400'. The melted portions of the main body 100' and cap 400' solidify to connect the

main body 100' and the cap 400'. Remaining portions of the main body 100' and the cap 400' are thick enough so that they are not melted or undesirably deformed by the ultrasonic radiation.

Figure 10A, 10B, 10C and 10D illustrate details of an another example of a slave clip. Figure 10A is a top view of slave clip 300'. Figure 10B is a front view of slave clip 300'. Figure 10C is a side view of slave clip 300'. Figure 10D is a blown-up view of a portion of Figure 10C. Slave clip 300' illustrated in Figures 10A, 10B, 10C and 10D is similar to slave clip 300 illustrated in Figures 5A, 5B and 5C except that the "U"-shaped projections 302a have been replaced by "Z" or "S" shaped projections 302a'. The projections 302a' extend from a top portion of carrier strip 302' (opposite from clips 304') and between each clip 304'. The projections 302a' are "Z" or "S" shaped in cross sections take in a direction which is perpendicular to carrier strip 302' and perpendicular to the length of carrier strip 302'.

The assembly of the grounding block using slave clip 300' is the same as in the above examples. However, contact between the main clip and the slave clip 300' is made by projections the "S" or "Z" shaped projections 302a' rather than the "U" shaped projections 302 (in Figure 5). Projections 302a' may have a spring-like structure so that the projections 302a' can be made longer than is absolutely necessary to assure contact with the main clip while allowing the length of projections 302a' to be made smaller if necessary when fitted in the hollow of the main body. Thus, lower tolerances for the associated dimensions of the slave clip are

acceptable. It is emphasized that the "S" and "Z" shape of the projections 302a' are merely exemplary and many additional shapes will be apparent to those skilled in the art. Also, although preferred, it is emphasized that these projections 302a' do not require a spring-like structure.

Because projections 302a' extend from the top of carrier strip 302' (and are not formed by bending carrier strip 302), the length of carrier strip 302' is set after punching or cutting carrier strip 302' from a piece of metal, thus more easily attaining accurate dimensions of slave clip 300'.

Again, it is emphasized that the above-detailed examples are set forth merely to describe the best mode of how to make and use the invention to one of ordinary skill in the art. The description is intended only to be exemplary and not limiting. For example, the above example describes a pair of clips 204 and 304 to form a terminal for contacting with pin 500. Other types of contacting structure will be apparent to those of ordinary skill in the art, for example, a contacting structure that does not necessitate use of slave clip or a contacting structure which uses additional elements. Similarly, the main clip and slave clip can be easily modified to accommodate different types of pins or other contacting structures. It is again emphasized that this block may be used to connect several wires to the same potential, other than a grounding potential. The term "grounding block" as used in this specification means blocks for connecting several wires to the same potential, whether this potential is a ground potential or not. Other modifications of the invention will be apparent to those of

ordinary skill in the art. The scope and spirit of the invention is intended to be defined only by the following claims.